International Educational Applied Scientific Research Journal
ISSN (Online): 2456-5040
Volume: 1 | Issue: 2 | November 2016

SIMULATION MODEL OF ORGANIZATIONAL CHANGE FOR ENVIRONMENTAL ENGINEERING CENTER CAMAGUEY

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ABSTRACT

In this work, using professional software Fuzzy Logic Toolbox from MATLAB 7.5 specifically that shows the simulation of a model that reflects organizational change process based on the approach to complexity at the Center for Environmental Engineering Camagüey (CIAC).

This organization, as a social formation itself is immersed in an environment that maintains the mutual relations of influence, and it provides the organizational complexity and multiple aspects of uncertainty or fuzziness of its boundaries.

It is through the interaction and interconnection of multiple and different factors in nature that based on the implementation of structural and functional systemic approach using a hermeneutic dialectic epistemology we intend to achieve in practice self-organization of the center.

Each of these factors or variables, such as nonlinear phenomena in itself, defined by human thought that is imprecise by nature, is expressed by fuzzy sets with overlapping boundaries, which, together with the rule base (existing knowledge system) and the inference mechanism conforms the fuzzy inference system (FIS) that shapes the future conduct of the Center and the interrelationships between all variables.

Integration into a single model of factors as diverse and yet highly interrelated with as participation, co-leadership and autonomy variable as "research & development willingness" and others like impacts, production, relevance and optimization to identify possible capacity variable analysis from a vision trans-disciplinary process of self-organization and school management.

INTRODUCTION

In analyzing the factors that drive the leading academic scientific institutions, it confirms the importance of change and the search for new organizational forms to meet the needs and the challenges of an increasingly diverse environment with a strategic approach, referring to the use of analysis of variables (internal and external) to establish strategies to guide the behavior of an organization in a period of time.

In order for organizations to self-organize in the first place, should be a process of awareness of their needs. Thus, it is possible to evoke the creative potential in the form of real actions (Diegoli, 2003)[1].

Most studies on complexity in organizations are focused on change processes and management, so it is obvious that in considering an organization as a complex system, so its elements are implicit in this complex dynamic.

This work deals with the concept of autopoietic organization as an organism, where the key variable that remains constant is its own organization, and the set of elements and relations between them that make the system as an entity in a given class, that it, generates, specified and maintained, produces its own components and again, repeatedly, compensating environmental disturbances by means of feedback and changing its structure (Maturana and Varela, 1994)[2]. However, there is no change of the system without changes in the environment (Luhmann, 1995)[3].

Moreover, Jose Navarro Cid, in his doctoral thesis demonstrated that organizations are open systems far from equilibrium, and a model complex, chaotic, far from equilibrium of the organization that succeeds in giving a better idea of the task of organizing in terms of the generation of meanings, in addition to changes occurring as Diegoli (2003), beliefs that there are shared paradigm and which ultimately reflect the patterns of everyday behavior, must be challenged.

Environmental Engineering Center of Camagüey has chosen to solve the following research problem: How to develop a

[1] Diegoli Samantha. (2003).
[2] Maturana Humberto, Varela Francisco. (1994).
[3] Luhmann, N. (1995).

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process of organizational change in the CIAC Camaguey so that it contributes to the formation of a way of acting developer?

We started with a model for the change of organizational process based on the approach of complexity from the application of functional and structural systemic approach using a hermeneutic dialectic epistemology in practice to achieve self-organization of the centre, as a social organization with structure dissipative, through change of behaviour patterns of the subjects, the motor force for the emergence of a scientific culture technology developer (Damera and Portuondo, 2009)[4].

Based on the theoretical model, defines the regularities of development where the dimensions are extracted and indicators of corporate technological scientific identity, so that compelled the sustainable institutional development, which consists of the practice through a strategy for organizational change management center, allowing the development of enterprise change management as essential quality and finally the validation of that strategy based on a model for that process of change based on the approach to complexity, which makes a triangulation of methods to validate it (participant-observation, criterion expert and focus groups).

Following the above analysis was necessary to model the dynamics of the variables, applying multivariate analysis using the professional software MATLAB 7.5, specifically the Fuzzy Logic toolbox and the simulation of the same which is the essence of this work.

Whereas the entity as autopoietic organization, and that the organization is related to the identity and structure to the network of relationships and the system varies the structure when adverse conditions has not change its identity, a study of the nodes within the network of social relations, which interact with most of the remaining nodes, identifying these as the fundamental (input variables) within the system.

The use of fuzzy logic techniques is desirable to solve very complex processes, i.e. when it lacks a simple mathematical model, or highly nonlinear processes, or processing of expert knowledge (linguistically formulated) can be played.

MATERIALS AND METHODS.

To model this system we use fuzzy logic (fuzzy) and specifically the fuzzy inference systems (FIS).

Zadeh, mathematician, professor at UC Berkeley in 1965 introduced the theory of fuzzy sets or fuzzy logic *(fuzzy logic)*. Fuzzy logic is a mathematical process that can represent and manipulate data that can not be defined precisely by the uncertainty they have. These data are the result of knowledge of a situation (phenomenon) that is being described, which in turn are in the form of implications or rules. Defined by the same reality in different degrees of truth or membership following reasoning patterns similar to human thinking that can take values in the range between 0 and 1.

The focus of this logic is that, unlike classical logic, fuzzy logic has the ability to reproduce an acceptable and efficient usual modes of human reasoning, considering that the certainty of a proposition is a matter of degree and therefore part of the basis of approximate reasoning and not the precise reasoning and classical logic does. Thus the most important features of fuzzy logic are: flexibility, tolerance of uncertainty, the ability to shape non-linear problems and its foundation in the language of common sense.

In other words, a fuzzy set does not meet the second and third Aristotelian principle, i.e that something can belong and not belong simultaneously to the same complementary set, simply because the criteria for membership are not clearly defined. (Munné, 2000)[5].

Fuzzy inference system (FIS) is a way to represent knowledge and incorrect information in a manner similar to human thinking makes and defines a linear correspondence between one or more input variables and output variable, that provides a basis from which decisions can be made to define or predict the behavior patterns of the same.

The methodology for constructing a fuzzy inference system involves the definition of input variables and model output, its categories or linguistic terms of incorporation of each fuzzy set and membership functions and leads to the creation of a model linking input variables and output through a set of rules defined in linguistic terms, which demonstrate the behavior and the interrelationship between those of the form "If - Then", for example:

IF (x is A) AND (k is B) THEN (z Is C), where

A and B are linguistic values of input variables X and K.
C is the output variable of Z.

In general, each variable considered in the analysis that may be defined by linguistic categories or labels depending on the variations of the same experience as these categories may be mild, moderate, medium, high, very high, and so on.

Each of these linguistic terms define a fuzzy set itself that is represented by a membership function μ - numerical value that expresses the linguistic variable.

The fuzzy rules determine the degree of presence or absence of interaction between 2 or more elements of fuzzy sets, referred to the association between a linguistic category of a variable with another category of another variable and consist of antecedent (premise) and consequent (concluded. The evaluation of the antecedent (If x is A & B is k) that allows the interpretation of the rule, meaning the values of input

[4] Damera Arnaldo, Portuondo Roberto (2009).

[5] Munné Frederick (2000)

variables to linguistic categories to the implementation of a fuzzy operator (Cartesian product) and ends when applied the result of the premise to the conclusion (z is C) through a membership function.

As numerical values of the input variables the actual values were taken from the center itself, on a scale of 1 to 10. As input variables, fuzzy inference system that determines the value of the output variable "research & development willingness" took the following elements:

1. Participation (P): percentage (%) of employees participation in the activities of the entity, primarily in research.
   100 P = # Participants / # Total workers * 100

2. Co-leadership (CP): % age of tasks that are not inherent to the person and the protagonist manages.

3. Autonomy inclusive (AI): % age of workers who handle the objectives with minimum control.

As FIS input variables I assess the output variable "transformative research capacity" take the following elements:

1. Impact (I): # of projects and relevant technical scientific service (TSC) recognized / Total # of Projects and TSC * 100

2. Results (R): %age compliance with the proposed objectives

3. Actions that contribute to the development impact of the territory
   Pe = # of actions that contribute to the development impact of the territory / # total shares * 100

4. Optimization (O): Compliance with maximum quality and saving resources

All these variables are represented by fuzzy sets as shown in Figure 1 used to define the variable "Participation".

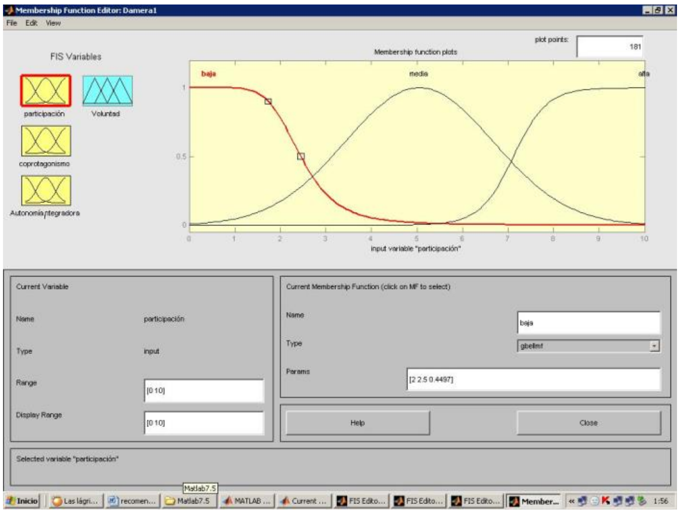

Fig.1 Input variable "Participation".

Fuzzy inference systems used can be seen in Figure 2 as the example for the output variable "Research & development willingness".

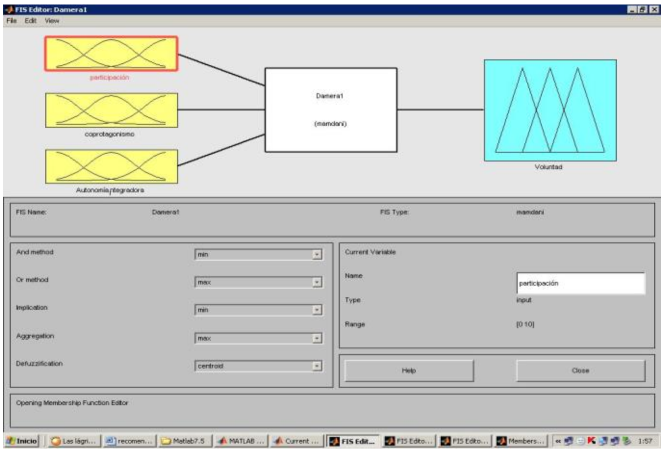

Fig.2 *Fuzzy inference system* "Research & development willingness*".*

For each of these inference systems are designed a fuzzy rule base, which represents the knowledge about it and the interrelationship between the input and output variables. For the output variable "Research & development willingness"; 27 rules were selected and for the variable "transformative research capacity" wete selected 54 rules. A group of these rules and the simulation environment for the values of the output variables can be seen in Figure 3.

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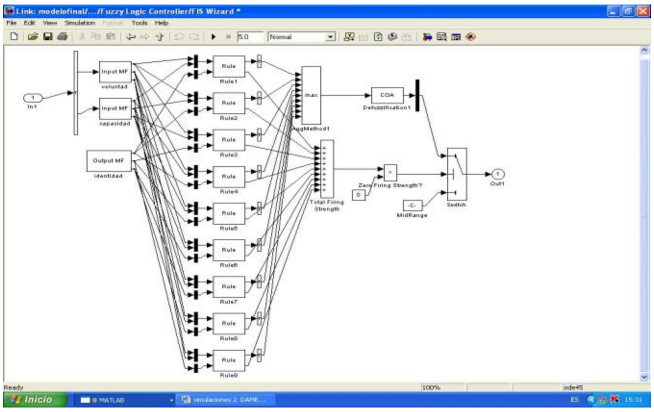

Fig.3 Set of rules environment.

After of obtaining the results of the fuzzy inference process, we proceeded to implement a third inference system (double fuzzification process), in which the input variables are the same output variables "Research & development willingness" and "Transformative research capacity" obtained above and the output variable is the "scientific technological identity" of the institution.

As in previous cases all these variables are represented by fuzzy sets similar to those in Figure 1. To compile the same we used a new base of fuzzy rules in this case consists of nine rules.

The final model of organizational change for Environmental Engineering Center Camaguey implemented with "Simulink" MATLAB 7.5 software can be seen in Figure 4.

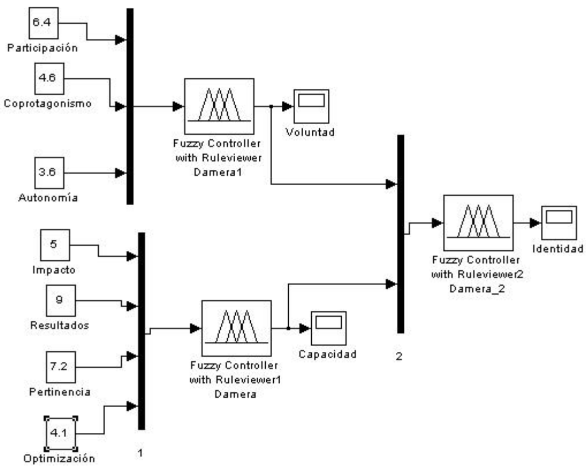

Fig.4 Model of organizational change for Environmental Engineering Center Camaguey implemented with "Simulink".

The result of applying the rules and the final reverse process or desfuzzification shown in Figure 5. For actual values of the input variables, the value of the "Scientific technological identity" obtained is six.

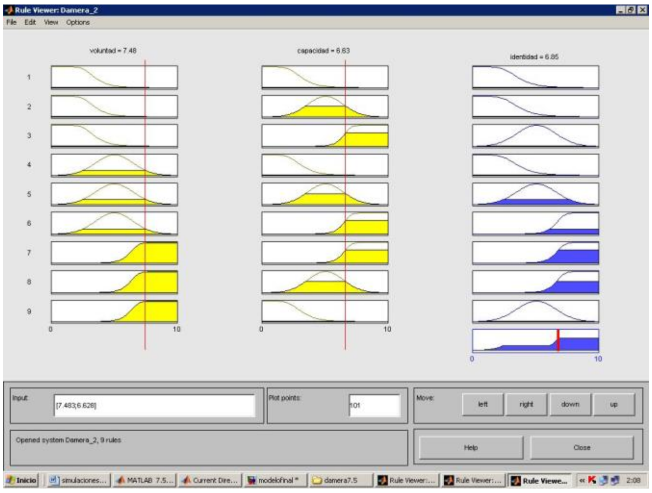

Fig.5 Defuzzification process.

The final product of this simulation is the three-dimensional graphic or surface behavior, which reflects the input variables of the third system of inference, in this case "Research & development willingness "and "Transformative research capacity" and the final output variable the entire model is the "Scientific identity technology" of institution.

This double fuzzification process increases the degree of accuracy of results. The final output surface can be seen in Figure 6.

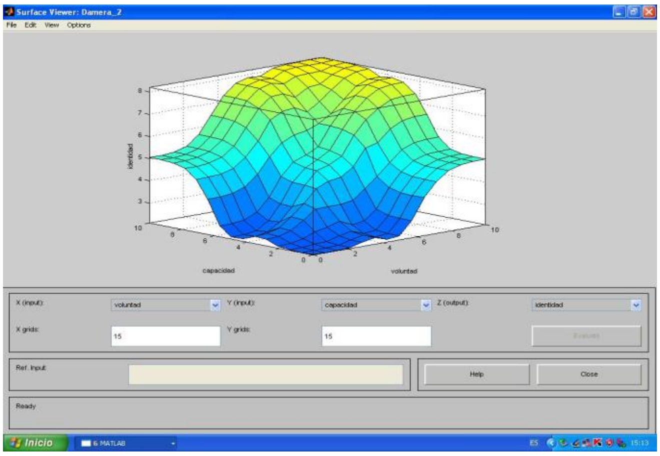

Fig.6 Surface.

CONCLUSIONS.

1. It had evaluated the fact positively that take participation, autonomy and co-leadership as integrative indicators of the "Research & development willingness", which is one of the dependent variables of the model and moreover agreed that participation, empowerment and inclusive co-leadership that can be considered as indicators because they are qualities or properties of the object that is directly observed, measured and quantified, which allows knowing the position of the

object at any given time, in addition to the integration of these three essential qualities of identity which is formed scientificly research, in the institution.

2. It had evaluated the fact positively that based on the indicators of "Transformative research capacity" of scientific production, relevance, impact and optimization. It was correct to take a "Transformative research capacity" as a dependent variable of model and, moreover, we highlighted their importance in validating the model, because of the measurement of the impact of scientific results, scientific production, satisfaction of social needs and the optimization of all processes which are vital to the successful development of the organization.

3. It is considered as a very successful experiment in this practice of the proposed model, it took the actual values of the input variables of the organization, which is a important source of validation.

4. Within the ranges established for each input variable through the simulation runs, where the output variable scientific technological identity is kept at a value of six,we can conclude that the system is open and far from equilibrium, where at the same time it was self-organized and the different variables reflect the transdisciplinary nature.

5. The difference between linear and non-linear management is: Linear management is trying increase all variables to improve the system (this is impossible to achieve) while nonlinear management is trying to keep the values of the input variables inside the ranges that are not converging around the range of that identity.

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